ON THE SEX OF HYBRID BIRDS.

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In a former paper[1] I have noted the difficulty of obtaining female hybrids from pigeons or doves of widely different parentage. Of the seven hybrid offspring of very distinct species then in hand, six were male. Since that time, through the courtesy of the Museum d'Histoire Naturelle in Paris and the Museum of Natural History in London, I have had the opportunity of examining a number of different hybrids in the family Phasianidæ and among them also I have found a remarkable predominance of males. In the following tabulations the sex of each hybrid, when known, and the parentage, is given, together with the date the individual was placed in the museum. It has been impossible to give the specific name always because a number of the specimens bore only the popular names. The letters placed after the year of accession indicate the respective locations of the specimen in question; thus, B = British Museum (Museum of Natural History); P = Museum d'Histoire Naturelle, Paris; C = Museum, University of Cincinnati.

GUINEA-FOWL × CHICKEN.

	Sex.	Date and Location.
Guinea-fowl × common fowl	= ?	1902 B.
Guinea-fowl × common fowl	= ♂	1899 B.
Pintade × Poule	= ?	1854 P.
Black Langshang Cock × Guinea-hen	= ♂	1903 C.
Black Langshang Cock × Guinea-hen	= ♂	1903 C.
Black Langshang Cock × Guinea-hen	= ♂	1903 C.
Black Langshang Cock × Guinea-hen	= ♂	1908 C.
Black Langshang Cock × Guinea-hen	= ♂	1909 C.

Thus, of eight guinea-chicken hybrids, the sex is known in six cases and it is invariably male.

[1] Guyer, M. F., "Spermatogenesis of Normal and of Hybrid Pigeons," Dissertation, University of Chicago, 1900. Also published as Bul. 22, University of Cincinnati, 1903.

PHEASANT × CHICKEN.

Chrysolophus pictus × Bantam fowl	= ♂	1890 B.
Phasianus colchicus × Game bantam	= ♂	1902 B.
Phasianus colchicus × Spanish fowl	= ?	1845 B.
Phasianus colchicus × Common fowl	= ♂	1884 B.
Phasianus colchicus × (Japanese long-tailed cock × common hen)	= ♂	1905 B.
Faison × Poule	= ♂	1851 P.
Faison × Poule	= ♂	1845 P.
Faison × Poule	= ♂	1836 P.
Faison × Poule	= ♂	1855 P.
Faison × Poule	= ♂	1813 P.
Faison × Poule	= ♂	1851 P.
Faison × Poule	= ♂	1851 P.
Faison × Poule	= ♂	1846 P.

It will be seen that of thirteen pheasant-chicken hybrids, the twelve of which the sex is recorded are all male.

PEAFOWL × CHICKEN.

Paon × Poule Cochinchinoise	= ♂	1907 P.
Paon × Poule Cochinchinoise	= ♂	1907 P

From the foregoing it will be observed that of the total of twenty-three hybrids from markedly different parentage (guinea × chicken, pheasant × chicken, and peafowl × chicken), each one of the twenty of which the sex is known is male.

PEAFOWL × PEAFOWL.

Pavo cristatus × *Pavo muticus*	= ♂	B.

PHEASANT × PHEASANT.

Chrysolophus pictus × *Phasianus reevesi*	= ♂	1887 B.
Hybrid *P. colchicus-reevesi* × *Gennæus nycthemerus*	= ?	B.
Chrysolophus pictus × *Phasianus colchicus*	= ♂	1855 B.
Hybrid *P. colchicus-reevesi* × *Gennæus nycthemerus*	= ♂	1904 B.
Gennæus horsfieldi × *Phasianus versicolor*	= ♂	1866 B.
Hybrid *P. reevesi-colchicus* × *Gennæus nycthemerus*	= ♂	1902 B.
Phasianus colchicus × *Gennæus nycthemerus*	= ♂	1902 B.
Hybrid *C. pictus-amherstiæ* × *Phasianus colchicus*	= ♂	1897 B.
Chrysolophus pictus × *Gennæus nycthemerus*	= ♂	1906 B.
Phasianus colchicus × *Chrysolophus pictus*	= ♂	1904 B.
Phasianus colchicus × *Gennæus melanotus*	= ♂	1865 B.
Phasianus colchicus × *Chrysolophus amherstiæ*	= ♂	1898 B.
Lophophorus impeyanus × *Euplocamus*[1] *melanotus*	= ?	1893 P.

[1] *Euplocamus* is a synonym of *Gennæus.*

[2] Presumably *C. pictus.*

Faisan doré[2] × Faisan commun[3]	= ♂	1842 P.
Faisan à collier[4] × Faisan argenté[5]	= ?	1886 P.
Faisan commun[3] × Faisan amherst[6]	= ?	1837 P.
Faisan doré[2] × Faisan ordinaire[3]	= ♀	1853 P.
Faisan commun[3] × Faisan argenté[5]	= ♂	1837 P.
Faisan commun[3] × Faisan argenté[5]	= ♂	1843 P.
Phasianus mongolicus × *Phasianus colchicus*	= ♂	1906 B.
Phasianus colchicus × *Phasianus reevesi*	= ♀	1904 B.
Phasianus colchicus × *Phasianus torquatus*	= ♂	1894 B.
Phasianus colchicus × *Phasianus reevesi*	= ♂	1894 B.
Chrysolophus amherstiæ × *Chrysolophus pictus*	= ♂	B.
Phasianus colchicus × *Phasianus reevesi*	= ♂	1897 B.
¾ *Chrysolophus amherstiæ* × ¼ *Chrysolophus pictus*	= ♂	1887 B.
Euplocamus[1] *swinhoii* × *Euplocamus nycthemerus*	= ♂	1882 P.
Euplocamus swinhoii × *Euplocamus nycthemerus*	= ♀	1875 P.
Euplocamus lineatus × *Euplocamus nycthemerus*	= ♂	1887 P.
Euplocamus lineatus × *Euplocamus nycthemerus*	= ♀	1878 P.
Euplocamus horsfieldi × *Euplocamus lineatus*	= ♂	1819 P.
Euplocamus horsfieldi × *Euplocamus lineatus*	= ♂	1869 P.
Faisan amherst[6] × Faisan doré[2]	= ?	1882 P.
Faisan amherst × Faisan doré	= ?	1902 P.
Faisan commun[3] × Faisan à collier[4]	= ?	1860 P.
Faisan commun × Faisan à collier	= ♂	1858 P.
Faisan commun × Faisan à collier	= ♂	1843 P.

Of a total of thirty-seven hybrid pheasants, nineteen have been from parents sufficiently widely separated to be ranked by systematists as separate genera or subgenera, and of these nineteen, fifteen were of known sex, namely, fourteen males and one female. Of the remaining eighteen there were twelve males, three females and three of which the sex was undetermined.

Thus of a grand total of sixty-one hybrids, the sex is known in fifty-one cases and among these there are only four females in all. Furthermore, three of these females were hybrids between species of the same genus, the other one, between species from genera not widely divergent. In hybrids between individuals of distantly related genera or between individuals from different subfamilies (*e. g.*, guinea × chicken) where the sex has been recorded it has been invariably male.

There are three possible sources of error in these data. In the

[3] Presumably *P. colchicus.*
[4] Presumably *P. torquatus.*
[5] Presumably *G. nycthemerus.*
[6] Presumably *C. amherstiæ.*

first place it is known that sterile females sometimes, although rarely, take on the male plumage, and it may be urged that there is no means of knowing certainly that the sex was determined beyond all doubt by opening the abdominal cavity and finding the testes. However, since the specimens had to be partially dissected before the skins could be mounted, it is reasonable to suppose that in the vast majority of cases the sex was thus accurately determined. The five guinea-chicken hybrids as well as the six dove and pigeon hybrids mentioned in my former paper were all dissected by me personally and consequently I am sure of their sex.

In the second place the objection may be raised that possibly the museums have preserved only the males, inasmuch as they make handsomer specimens and are not as similar in appearance as female pheasants. There is, of course, a possibility of this, especially in the case of hybrid pheasants from closely related species. Hybrids from widely different parents are so rare, however, that there is every probability that if there had been females they as well as the males would have been preserved. As a matter of fact, the few female pheasant hybrids that I have been able to find in museums are not similar in appearance nor do they resemble the males. As *hybrids* they are as interesting in every way as the males and it seems probable, therefore, that had there been more of them they would have been preserved. When due allowance is made for all errors the facts still indicate that there is a marked tendency for hybrids, especially those from widely separated parents, to be male.

Lastly, there is the remote possibility that there has been a greater mortality among the females in early life. In the few cases (guinea-chicken hybrids and various pigeon hybrids) of which I have data regarding the number of eggs laid and the history of the young, there is no evidence of such mortality.

It may be noted in passing that in the collections of the British Museum there is to be seen a hybrid between individuals of two different families, namely, a penelope (Family Cracidæ) and the common fowl (Family Phasianidæ). This hybrid resembles more the fowl than the penelope. Unfortunately the sex is not recorded.

In looking over the literature of the subject to see if anything had been recorded concerning the sex of hybrids outside the group Phasianidæ, I found that in general little attention had been paid to it. Some mention is made of the sex of hybrids in Suchetet's[1] voluminous work on hybrid birds. In speaking (p. cxvii) of hybrids and mongrels, he asserts that among the former he believes there are more males than females, and he cites various authorities in substantiation of his belief. Thus, according to data collected by Buffon, there are more male than female mules and Buffon asserts, furthermore, that among hybrid birds the number of males exceeds very much that of females. Suchetet cites the following figures from Buffon: the proportion of males to females in hybrids between the he-goat and the ewe are 7 to 2; between the dog and the wolf, 3 to 1; between the goldfinch and the canary, 16 to 3. Suchetet cites still further examples from other authorities, but he seems not to have gone over his own extensive notes on hybrids with this question of sex in mind. For example, on pages cxxi–cxxxiv he gives a statement in tabular form of data collected from some eighty-five public and private museums concerning in all 234[2] specimens of hybrids between wild birds (*i. e.*, not domesticated) or of forms reputed to be such hybrids. Since in many cases the sex of these hybrids has been given, I have gone through the tables and arranged the birds according to sex as far as it is indicated, with the following results:

Of hybrids between species bearing the same generic name there are in all 124, of which 72 were male, 18 female and 34 of undetermined sex. The remaining 110 hybrids were between individuals bearing different generic names and of these 74 were male, 13 were female and 23 were of undetermined sex. Thus it will be seen that the males far outnumber the females in each case. Furthermore, this would remain true in the proportion of about 3 to 2, even should it be counted that all those of *undetermined* sex were female!

In his later amplifications of this list he discusses (p. 507) 48

[1] Suchetet, André, "Des Hybrides à L'Etat Sauvage; Oiseaux," Vol. I., 1896, Lille. A large volume of over 1,000 pages.

[2] Suchetet states the total as 236 but he has made an error of 2 in his addition on page cxxxii.

additional hybrids between *Tetrao tetrix* and *Tetrao urogallus,* of which 40 are male and 8 female. Again, page 573, he lists 20 hybrids of *Lagopus albus* and *Tetrao tetrix,* of which 13 are male and seven are female.

As to the general bearing of these facts upon any one of the numerous theories of sex-determination, the writer does not feel disposed to dogmatize, although certain suggestions present themselves. For a general and unbiased statement of our present knowledge regarding the question of sex-determination, the reader may consult the recent publications of Thomson[1] or of Morgan.[2]

Both of these writers agree that when all the evidence is considered it does not seem improbable that the conditions which regulate the development of sex may be different in different kinds of animals. Regarding the sex-determining influence of nutrition and temperature, either directly on the developing organism or through its parents, Thomson points out that while the evidence in any given case is inconclusive, still when all the cases are taken together, "they have a certain cumulative suggestiveness which would warrant further experiment—particularly as regards the lower animals and the indirect influence on offspring through the parents" (1908, p. 490).

In general, where the experiments tend to show that nutrition is a factor after the period of fertilization, it has been the production of females that was supposedly favored by such increased nutrition; the question being apparently one of increased constructive metabolism. It would follow that anything tending to retard or hold at a low ebb the constructive phases of metabolism, especially during early embryogeny, would be inimical to the production of females. Now in the case of hybrids, and particularly those from widely separated parents, there would in all probability be more or less default in the metabolic processes because of the incompatibilities which must necessarily exist between two germ-plasms so dissimilar. It seems not improbable, therefore, that this might be the determining factor in the production of an excess of males in the case of such hybrids.

[1] Thomson, J. Arthur, "Heredity," London, 1908.

[2] Morgan, T. H., "Experimental Zoology," New York and London, 1907.